3.3 Annex III – Energy Efficiency

Improving energy efficiency is a major component of China's energy development strategy. China is achieving great successes in improving energy efficiency, as evidenced by sustained rapid economic growth with relatively low energy consumption growth. During the years from 1980 to 1996, annual GDP increases averaged 10.1 percent, whereas annual energy consumption increases were only 5.35 percent. [24]

One measure of efficiency is called energy intensity, or the energy used to produce a unit of GDP. Over the past two decades China has been consuming more energy, but the GDP has been growing much faster. As a result since late 1970s, energy intensity in China has been declining at a rate of 4.5 percent per year. If energy intensity had not been reduced, the energy consumption today would be more than double. [25] (See figure 12.)

In the past, improving energy efficiency was employed simply for balancing energy supply and demand. Efficiency is now regarded as a means to strengthen competitiveness, reduce environment pollution, and achieve sustainable development. Although there has been some recent economic slowdown in China and throughout Asia, in the long term China's economy is expected to increase at moderately high rates for the foreseeable future; energy demand is also expected to increase, but at a slower and decreasing rate. Compared to most industrialized countries, China's energy efficiency is low, and potential of improving energy efficiency is still very large. Therefore, improving energy efficiency will continue to be a high priority area [26].

3.3.1 Technology and Application Descriptions

In terms of energy use per unit of GDP, China has one of the most energy-intensive economies in the world and China's industrial sector consumes more than two thirds of China's total energy. China's energy consumption is concentrated in industries such as chemicals, primary metals, cement, and pulp and paper – industries that are typically energy-intensive. In these industries, energy intensity is often compounded by inefficiencies resulting from other factors, such as the unavailability of efficient technologies; small plants that cannot attain economies of scale; and problems with maintenance of energy-efficient operations within plants [27]. Also, industry in China is highly dependent on the direct use of coal (70 percent).

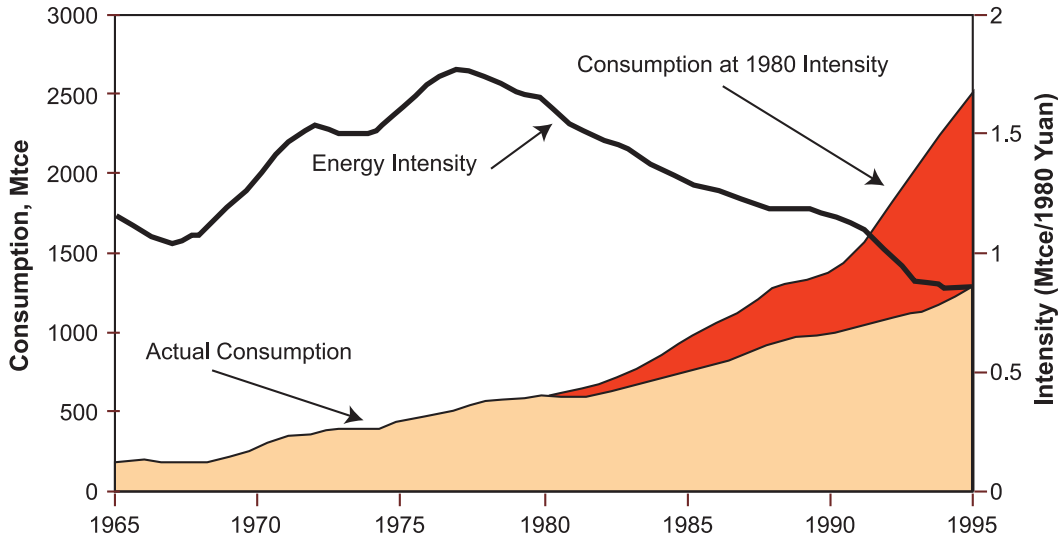

Figure 12. China's Energy Consumption and Energy Intensity, 1965 - 1997.
Sources: Pacific Northwest Laboratory, http://www.PNL.gov/China/engycons.htm [25]; and China Energy Databook, J.E. Sinton, et. al., Lawrence Berkeley National Labs, 1996; China Energy Annual Review, 1996, SETC, Beijing, China.

China's intent to improve energy efficiency, as evidenced by China's Agenda 21 Program and Ninth Five-Year Plan, creates opportunities for US-China cooperation:

- In the industrial area, opportunities include improved waste heat, gas, and waste steam recovery; expanded use of cogeneration; improved industrial furnaces and kilns; better monitoring and control systems; the use of improved insulation; and other renovations in thermal and steam systems. There is also an opportunity to install energy-efficient equipment such as boilers, electric motors, and motor systems, and associated electrical equipment.

- In the building sector, due to China's construction boom, substantial opportunities for improvement exist in new construction and retrofits, building envelopes, heating, ventilation and air conditioning systems and controls, and lighting systems.

- Appliance purchases are increasing, creating an opportunity to educate consumers about the advantages of buying energy-efficient products and providing a need for cooperation on energy-efficient codes and standards.

3.3.2 Areas of Cooperation

The US-China energy efficiency activities are conducted through teams with designated team leaders; the teams are composed of representatives from industry, state agencies, energy associations, the DOE national laboratories, and other interested parties. China has implemented a similar team arrangement. A steering committee was established to coordinate the US-China energy efficiency activities under the Protocol for Cooperation in the Fields of Energy Efficiency and Renewable Energy Technology Development and Utilization. The steering committee is chaired jointly by Mr. Li Hong Xun of the State Development and Planning Commission and Ms. Denise Swink of the DOE. The committee consists of representatives of the State Planning and Development Commission, the DOE, and China and U.S. team leaders. On May 5-7, 1997, the first US-China Energy Efficiency Steering Committee Meeting was held in Beijing. Annex III, signed in October 1996, covers energy efficiency activities in energy policy, information exchange and business outreach, district heating, cogeneration, energy-efficient buildings, energy-efficient motors systems, industrial process controls, lighting, amorphous core transformers, and finance. A summary of the actions and accomplishments, as of October 1998, in each of the ten areas follows.

3.3.2.1 Energy Policy – The goal of the activity is to collaborate on policies to promote energy efficiency. After documenting ongoing U.S.-China energy policy collaborations, emphasis was placed on (1) assessing the applicability of U.S. energy policy to China, and (2) assisting in standards development in China.

In July 1997, DOE's Policy Office sent an extensive list of information on laws, regulations, and policy implementation to the State Planning Commission. On November 1, 1997, the National People's Congress passed the Law on Energy Conservation of the People's Republic of China, which took effect on January 1, 1998. Subsequently, a U.S. delegation visited China to participate in a workshop on energy efficiency policy. Held on December 11-12, 1997, in Beijing, the workshop featured discussions about implementation of U.S. energy efficiency laws and policies at the Federal and state levels. The U.S. delegation included representatives from the Natural Resources Defense Council, the Alliance to Save Energy, the American Council for an Energy-Efficient Economy, California Energy Commission, Lawrence Berkeley National Laboratory, and the DOE.

Collaboration is also underway to develop guidelines and standards for key products, refrigerators, air conditioners, ballasts, and fluorescent lamps. The China State Bureau of Technical Supervision is promul-

gating energy efficiency standards. Standards for refrigerators were established in 1997 and standards for fluorescent lamps began in 1998; standards for air conditioners are due in 1999. To assist in creating refrigerator energy efficiency standards, Lawrence Berkeley National Laboratory trained three visiting Chinese in the use of energy efficiency analysis tools, during June 1996.

3.3.2.2 Information Exchange and Business Outreach – The information exchange activity acts as a focal point for information collection and dissemination of information on Chinese energy efficiency issues. Information is disseminated on technologies, market conditions, and other topics of interest. World Wide Web sites for China information created at Pacific Northwest National Laboratory (www.pnl.gov/china) and the Beijing Energy Conservation Institute (BECon) (www.gcinfo.com/BECon) include: technical papers; newsletters; links to other sites; and statistics on China's energy, environment, and economy. A monthly China EE Info newsletter is also posted on these web sites. In response to questions posed by U.S. firms about China's electricity sector, Pacific Northwest National Laboratory, BECon, and China's Energy Research Institute jointly published a comprehensive report on China's electricity options in June 1998 [25]. The report is available on Pacific Northwest National Laboratory's web site.

3.3.2.3 Energy-Efficient Electric Motor Systems – The U.S. and China are working to facilitate the development, commercialization, and use in China of high-efficiency motors, motor speed controls, and other technologies and practices to improve motor system efficiency. A study of the Chinese motor market, funded by the DOE, was conducted by the American Council for an Energy-Efficient Economy in conjunction with the Beijing Energy Conservation Institute and the Shanghai Electric Apparatus Institute. The published study is available from the American Council for an Energy-Efficient Economy. In addition, the U.S. team has provided data on motors, programs, and products to China and is helping U.S. motor manufacturers assess opportunities for joint ventures in China.

Efforts are now focused on developing and conducting a Chinese Motor Challenge Program based on the successful DOE motor program. As part of the activity, data is being exchanged on motor systems, including fans, compressors, and pump systems. Discussions with the China Energy Conservation Investment Corporation in December 1997 resulted in an agreement to hold a Motor Challenge workshop in Beijing in May 1998. The U.S. delegation included representatives from the American Council for an Energy-Efficient Economy, Lawrence Berkeley National Laboratory, and U.S. industry. Following the workshop, the U.S. drafted a revised action plan for a China Motor System Energy Conservation Program. The China Energy Conservation Investment Corporation reviewed the plan, which includes background information, program goals, and program plans for the short, medium, and long-terms. The project's goal is to establish a major national program beginning in one province thus providing a laboratory to test concepts for the national program. Funding for this program is being sought.

3.3.2.4 District Heating – As part of the district heating plan to implement retrofits in five district heating sites in China, heat meters were installed in two Yantai apartment buildings and thermal regulating valves were installed in one. Started in November 1997, the demonstration project was completed in spring 1998. Relative energy use and savings, as well as residents' comfort, are being assessed. An evaluation report will be released in the near future pending

Figure 13. District Heating Project in Beijing

completion of discussions with China's Ministry of Construction. The Ministry of Construction is considering extending the project to the entire Yantai district heating system. A workshop to disseminate the demonstration's results to a broad Chinese audience is being considered.

3.3.2.5 Cogeneration – The objective of the cogeneration activity is to promote cogeneration projects in China with U.S. investors and partners. As part of this activity, a June 1996 U.S.-China Cogeneration Experts' Seminar in Washington, D.C., was organized by the China Energy Conservation Investment Corporation, Energy Resources International, and Lawrence Berkeley National Laboratory. Key Chinese cogeneration developers and policy staff met with interested U.S. private sector partners and presented information on proposed cogeneration projects open to U.S. investment.

The China Energy Conservation Investment Corporation prepared documents describing cogeneration in China, the approval process for cogeneration projects, and related policies. Because of the large economic changes that have taken place, these documents now need to be revised. To reduce the transaction costs of cogeneration projects in China, the U.S. team drafted model documents for power purchases, steam sales, and joint venture agreements. In July 1998, the U.S. team provided Chinese and English versions to the Chinese Energy Conservation Investment Corporation, who distributed them to national and local-level stakeholders. The Chinese Energy Conservation Investment Corporation consolidated comments and plans to use the documents as models for all cogeneration projects in China.

3.3.2.6 Energy-Efficient Buildings – In January 1998, an action plan was completed. The plan recognizes the need to improve mutual understanding of the building industry in the U.S. and China and to recognize the applicability of U.S. energy-efficient building technologies in China. China and the U.S. are planning two workshops. The first workshop was held in November 1999 in the U.S., and will be followed by one in China. To assist with preliminary planning, the DOE's Office of Building Technologies is sponsoring a visit by two Chinese researchers to work at Lawrence Berkeley National Laboratory. The researchers, Professor Tu Fengxang (China Building Energy Conservation Association) and Liu Jianping (China Energy Conservation Investment Corporation) will prepare background information and assist in organizing the workshops.

3.3.2.7 Energy-Efficient Lighting – China's Green Lights Program is one of the major energy conservation programs in the Ninth Five-Year Plan. As part of this program, China is working to increase the quantity and quality of high-efficiency lighting products and to promote efficient products. The lighting plan will assist the Green Lights Program in several activities: training, product certification and labeling, lighting standards, public information, and facilitating joint ventures.

Figure 14. Energy Efficient lamps are manufactured in China and are widely used to save electricity

In Summer 1997, a Chinese Green Lights team, sponsored by a United Nations Development Program project, visited U.S. manufacturers and Lawrence Berkeley National Laboratory and U.S. experts presented lectures at an annual Green Lights conference in Beijing. In addition, a delegation from the State Bureau of Technical Supervision visited Lawrence Berkeley National Laboratory in Fall 1997 to work on developing a product testing, a certification, and labeling program. In May 1998, a decision was made to pursue a Global Environmental Facility grant that will broaden the prior China Green Lights program into a national effort. Key program elements are: continuation of product certification and labeling program; improved quality of efficient lighting products; facilitation of bulk

purchases; development and implementation of education, promotional, and finance programs; development of design and product standards; and documentation of market trends.

3.3.2.8 Amorphous Core Transformers – Amorphous metal is a new material used in transformer cores, that lowers energy losses in devices used for raising and lowering electric power voltages. The goal of the amorphous metal transformer activity is to raise the design and manufacturing level of amorphous metal cores and transformers in China and promote the application of amorphous metal distribution transformers, thereby reducing energy loss and increasing energy efficiency. Cost reduction is important and Allied Signal, the U.S. team leader, has been working with Chinese transformer manufacturers to reduce price premiums for amorphous metal transformers from 70 percent in 1995 to 25 percent in 1997, with a target of less than 20 percent after 1999.

In January 1998, the State Planning Commission issued a letter outlining the steps that it will take to promote the production of amorphous metal transformers on a widespread basis in China. In May 1998, Allied Signal and General Electric (GE) concluded an agreement with Shanghai Zhixin Company to license GE's amorphous metal technology. Construction of a plant is underway and start-up is expected during 1999. Until then, Zhixin is importing finished transformers from GE and plans to purchase amorphous cores from Allied Signal's plant in Pudong. With completion of the new plant, the price premium goal of less than 20 percent will be met.

3.3.2.9 Industrial Process Controls – The objective of this activity is to implement process improvements in at least nine different industrial firms in China. The plan calls for the identification of candidates for process improvements in at least three plant facilities, within three process industries. Subsequently, participants would conduct workshops, site visits, and contract negotiations to implement the installations of advanced process control technologies. Current efforts focus on how to fund the evaluations that are required to implement the plan.

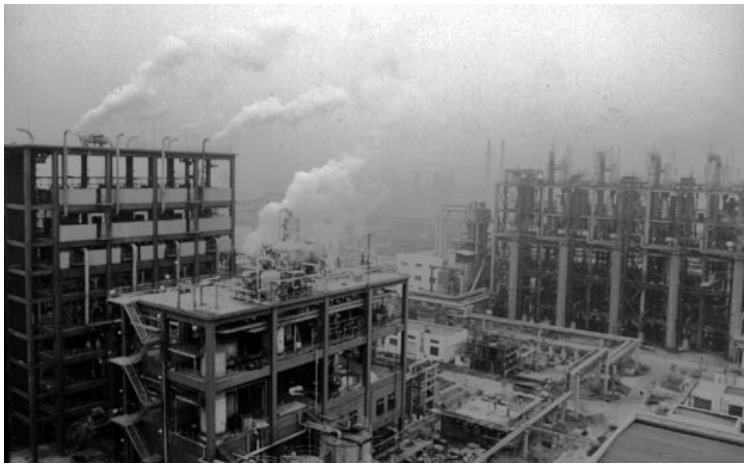

Figure 15. Coking and chemical plant in Shanghai – Industrial process control can substantially improve operating efficiency in many industrial plants

3.3.2.10 Finance – The objective of the finance activity is to identify constraints to energy efficiency finance in China, and recommend options for energy efficiency financing. The team will address three key issues: (1) transparency in companies – by identifying the parties with authority to implement contracts and projects; (2) security – by providing repayment guarantees and financial; and (3) initial project support – by finding local sources of support for feasibility studies and other initial project costs.

In May 1997, Pacific Northwest National Laboratory hosted a representative of the China Energy Conservation Investment Corporation to work on financial issues and potential future joint cooperation. The U.S. team is continuing efforts to identify and finance energy efficiency projects. Efforts by the China Energy Conservation Investment Corporation to produce a guide book for U.S. companies on the project approval process in China have been put in abeyance until the reform process is closer to completion.